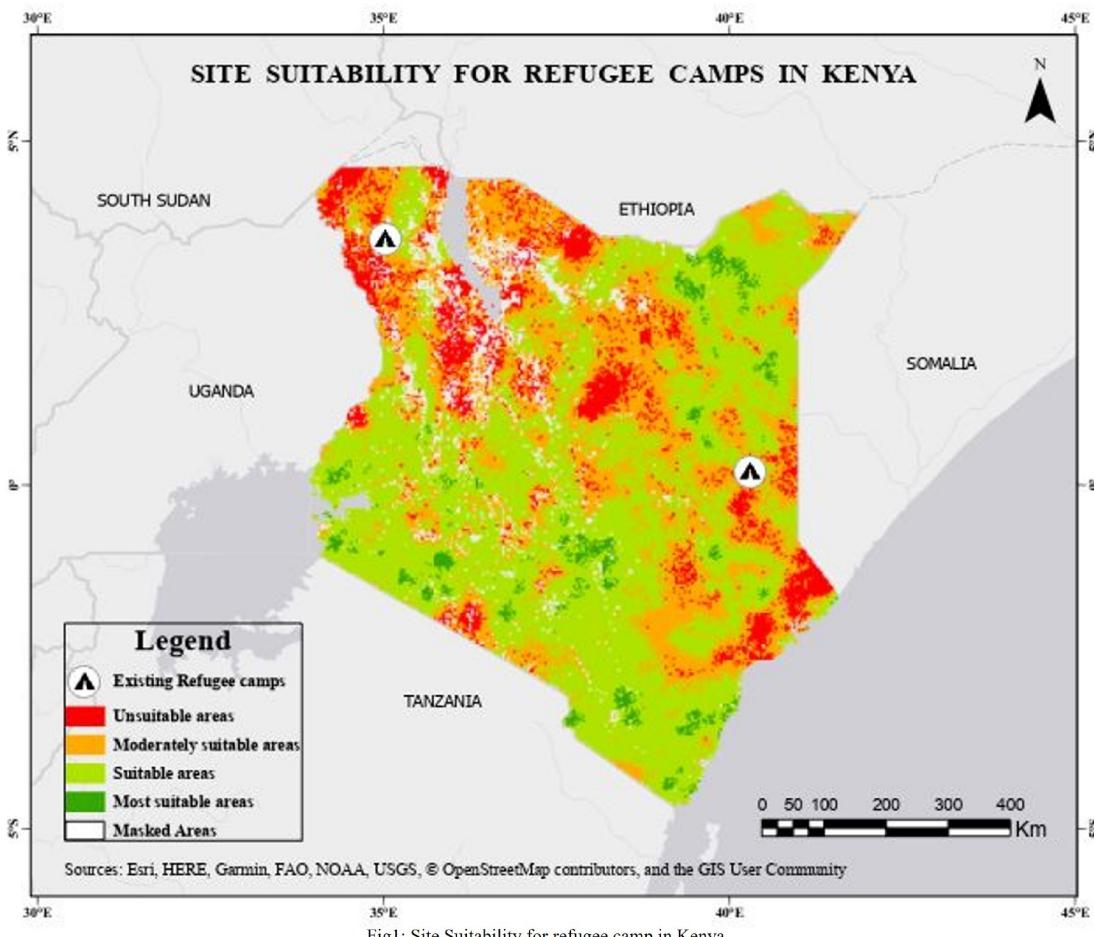


## 1. Introduction and Rationale

Kenya is amid a rapidly escalating refugee crisis. There are two major refugee camps in the country. They are Dadaab Refugee camp, the world's oldest and largest refugee camp with over 300,000 population in eastern Kenya, and Kakuma Refugee camp in North-West Kenya. Most refugees in Kenya originate from Somalia (54%). Other significant nationalities are South Sudanese (24.6%), Congolese (9%), Ethiopians (5.8%). Almost half of the refugees in Kenya (44%) live in Dadaab, 40% in Kakuma, and 16% in urban areas.<sup>[1]</sup> This puts immense pressure on existing refugee camps. Refugee camps are often overcrowded, which can create security issues and strain the camp infrastructure, supplies, officials, and other areas, and this calls for the setting up of new camps at suitable locations.<sup>[2]</sup> This work aims to use Geographic Information Science(GIS) to produce a map that will aid in carrying out humanitarian operations by finding a suitable location for refugee placement based on environmental and social factors.

## 2. Critical Analysis of source data

In this study, data were collected from various sources. Shuttle Radar Topography Mission (SRTM) 30m resolution Digital Elevation Model(DEM) was taken from the Regional Centre for Mapping of Resources for Development (RCMRD) to calculate the slope. The limitation of the DEM was that due to the boundary dispute between Kenya and South Sudan, the DEM available had the 1914 Border Line (Sudan's claim), which resulted in clipping all the other datasets to the available DEM size. As a result, a small part of North-West Kenya could not be included in the analysis, as shown in Fig1. The conflict data were procured from the Armed Conflict Location & Event Data Project (ACLED) 1997 to 2021. However, in this study, conflict data were considered from 2007 onwards, after the political, economic, and humanitarian crisis amplified in Kenya post-election results. ACLED uses a wide range of sources from multiple regions with different methods and biases to collect data and thus forms authentic data sources. In this study, conflict sites include all types of conflicts such as riots, protests, sexual violence, explosions, airstrikes, etc., that resulted in fatalities. This assumption might give a distorted image of reality as conflict sites that did not result in fatality were not considered. However, this was done to reduce the analysis's complexity and make sure that very high-risk areas were excluded. Data to calculate the distance to roads, health facilities, and existing camps were collected from Humanitarian Data Exchange (HDE). In the health facilities shapefile, several types of facilities were combined, such as hospitals, pharmacies, clinics, etc., to make the health facilities layer, and it was updated in March 2020, therefore quite reliable and up to date. However, the road shapefile considered was last updated in August 2017 and might not include the latest roads build. Furthermore, the Landuse shapefile was taken from IGAD Climate Prediction and Application Centre(ICPAC). Landuse shapefile was updated in 2015, and since a lot might have changed, which will influence the analysis. However, overall, the data used in the analysis are from well-grounded sources and are good enough to make a productive analysis.



## 3. Methodology

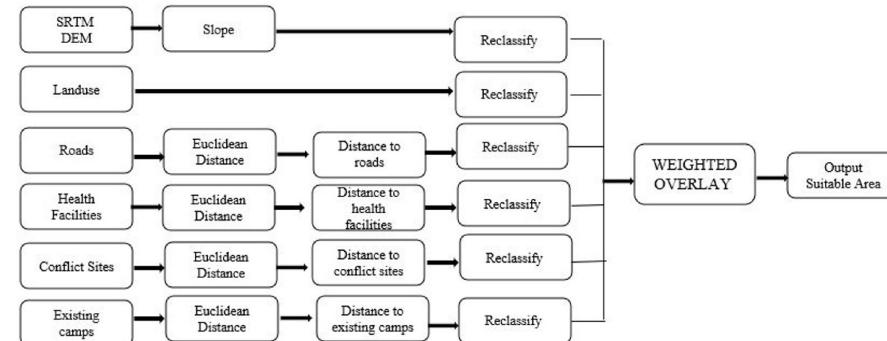


Fig 2: Flowchart of methodology

Table1: Weightage of various indicators

Type	Factor	Weightage	Explanation
Environmental	Slope	15%	The slope should be gentle, between 2% and 5-6% gradient for proper drainage, gravity water distribution, and agricultural opportunities. Flat sites (0-2%) often face drainage problems and are likely to become marshy in the wet season. Slope of more than 30% is masked out as it is not suitable to build the camp there.
	Landuse	12%	Grassland and Shrubland were chosen as the most suitable land to build a camp on because the area is open and easy to clear areas for structures. Forest was given the lowest ranking. Wetland, water bodies, and bare areas were masked out as per guidelines of UNHCR.
Social	Distance to roads	22%	It should be walkable for the people residing in the camp to reach a major road of the country.
	Distance to health facilities	22%	It is assumed that refugees will be commuting to avail themselves of the health facilities only if it is a walkable distance from the camp. Because of this, distance between 5Km is given the higher ranking.
	Distance to conflict areas	22%	The camp should be away from conflict areas, that is why within 5Km of conflict area, the lowest ranking is given. And as we move from conflict sites, the ranking increases.
	Distance to existing camps	7%	It is important to consider the location of the existing camp so that the new camp opens at a distance and can cater to diverse groups of people.

## 4. Cartographic principles and design consideration

The main content of the poster is one map of site suitability, and it is supported by three smaller maps (distance to roads, health facilities, and conflict sites). Out of the six indicators, these maps were chosen based on their weightage. In the main map, a base map is added to show the international boundary, thus providing context to the refugee movement. The base map also provides valuable insights into the boundary dispute between Kenya and South Sudan. A Flowchart has been used to show the clear-cut methodology, and one table is used to concisely elaborate the weightage and thinking process behind providing that weightage. Finally, a camp symbol represents the existing refugee camp.

- Simplicity-** Simple Base map is chosen to give context to the problem. Moreover, the overall look of the maps has been kept simple, neat, and easy to understand.
- Repeatability-** In bigger and smaller maps, the scale value, legend placement, north arrow, latitude-longitude, and scale are kept the same. Similarly, in the three smaller maps, the similarity is maintained in scale, title, legend, latitude-longitude.
- Visual Contrast-** The main map has visual contrast and attracts the audience. Also, the poster layout is black and grey because many colors are used in the maps.
- Overall balance and composition-** There is a balance between the text, table, map, and flowchart. Each subdivision has been given equal consideration.
- Color-** In the site suitability map, green and red are chosen to indicate the most suitable and unsuitable areas, respectively. White color is used to show masked areas. Gradient color is used in the three smaller maps where darker color signifies lesser distance and vice-versa. Roads are given brown color; conflict sites are given red as a danger sign. As red is used for conflict sites, purple indicates the health facilities.

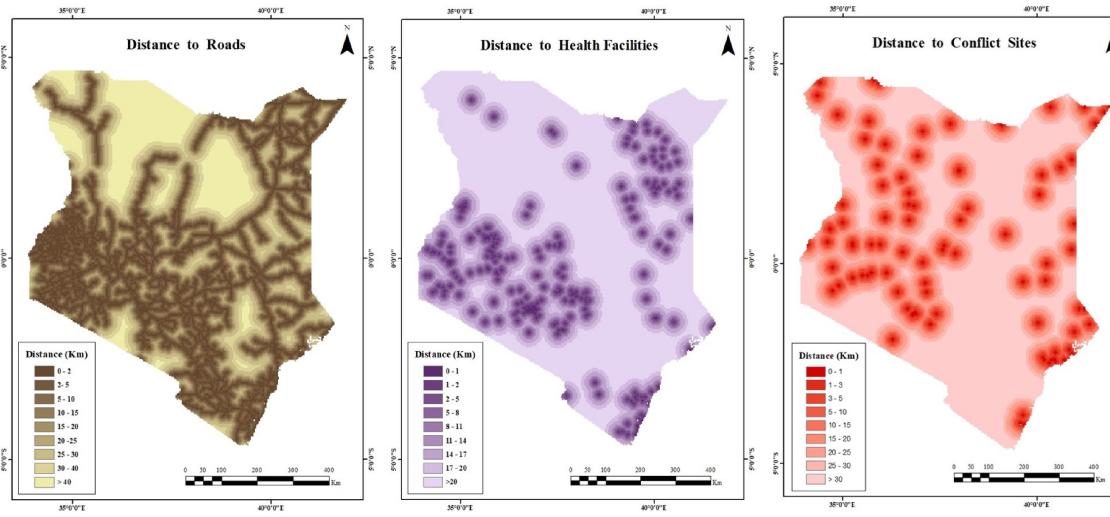


Fig3: Distance to roads, health facilities and conflict sites

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